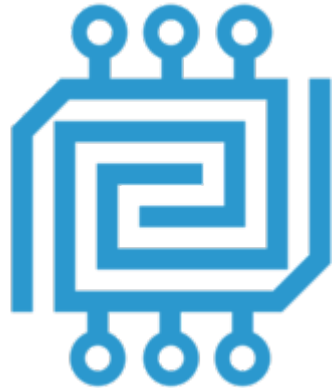
pyfda

Python Filter Design and Analysis

Dr. Christian Münker



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About me

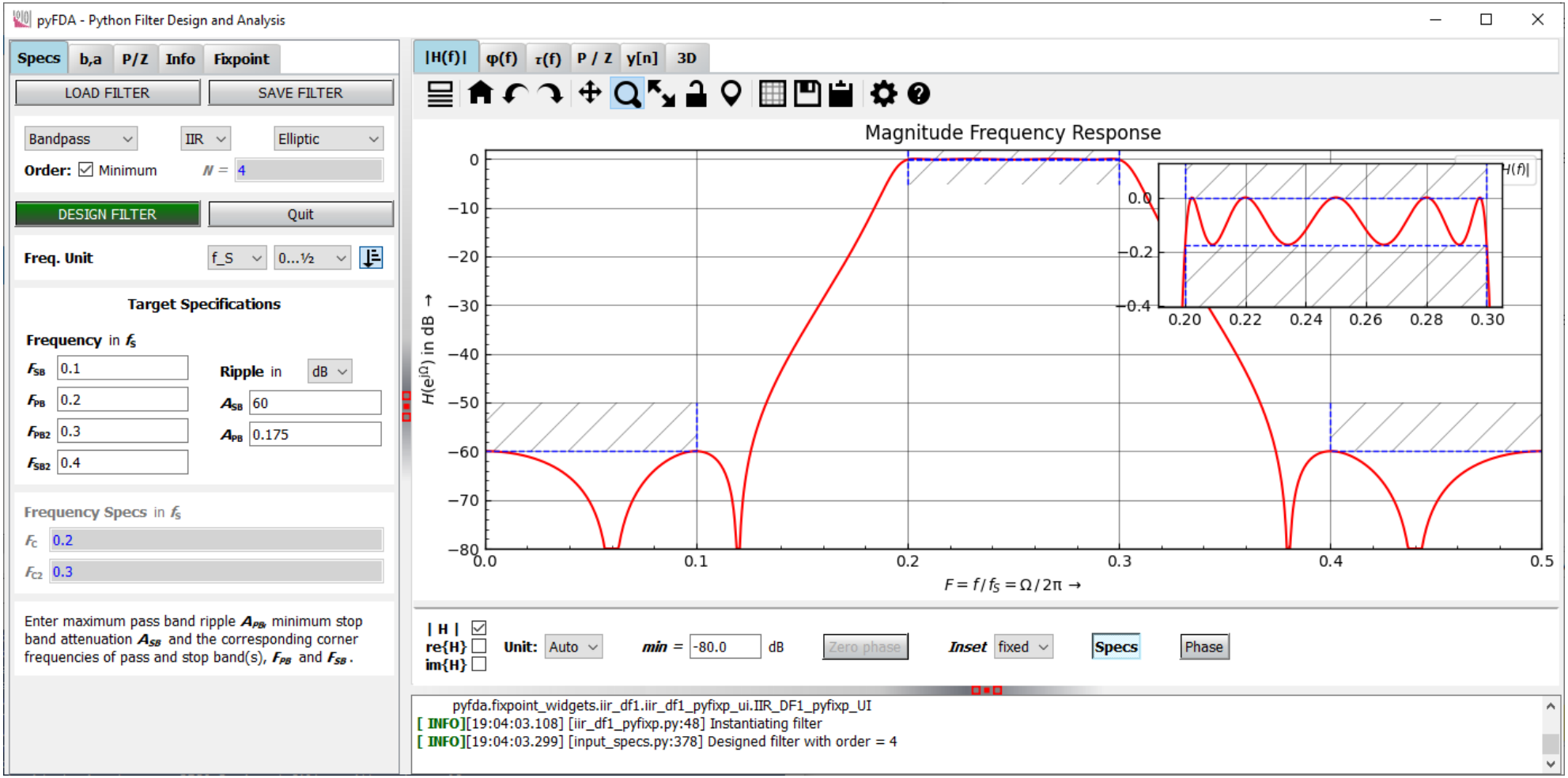
Since 2008: Professor for analog circuit design and digital signal processing at the Munich University of Applied Sciences

1993 – 2008: Mixed-signal chip designer a.o. with Infineon and Plessey

- RF-SOCs and -PLLs
- Built-In Self Test and Calibration
- Mixed-signal and behavioural simulation: SPICE, VHDL, Verilog(-A)

Interests: Python, DSP, FPGAs, circuit design, FOSS design flow, electronic music & music electronics, modular synths

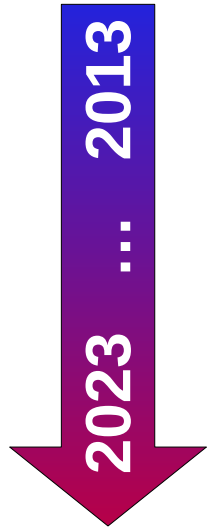
pyfda: Python Filter Design and Analysis



github.com/chipmuenk/pyfda: Self-expanding archives for Windows and OSX, **flatpak** for Linux or simply **pip install pyfda**

Motivation and History

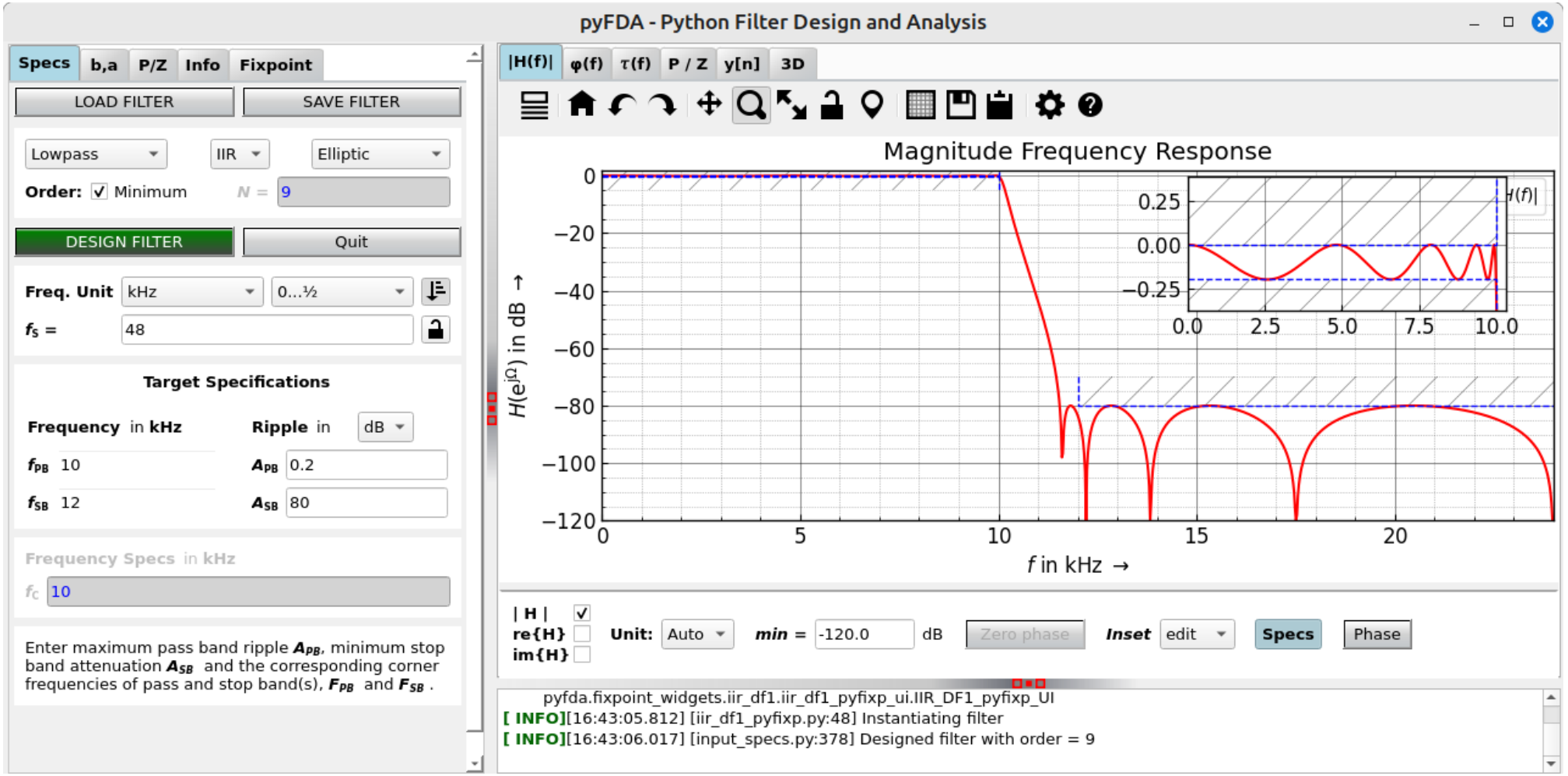
- Learn Python and QT (me)
- Interactive application for DSP lectures (me)
- Plots for lecture slides and scripts (me)
- Easy-to-use permissive license tool (DSP students, R & D)
- Fixpoint arithmetics in time and frequency domain (R & D)



Next step

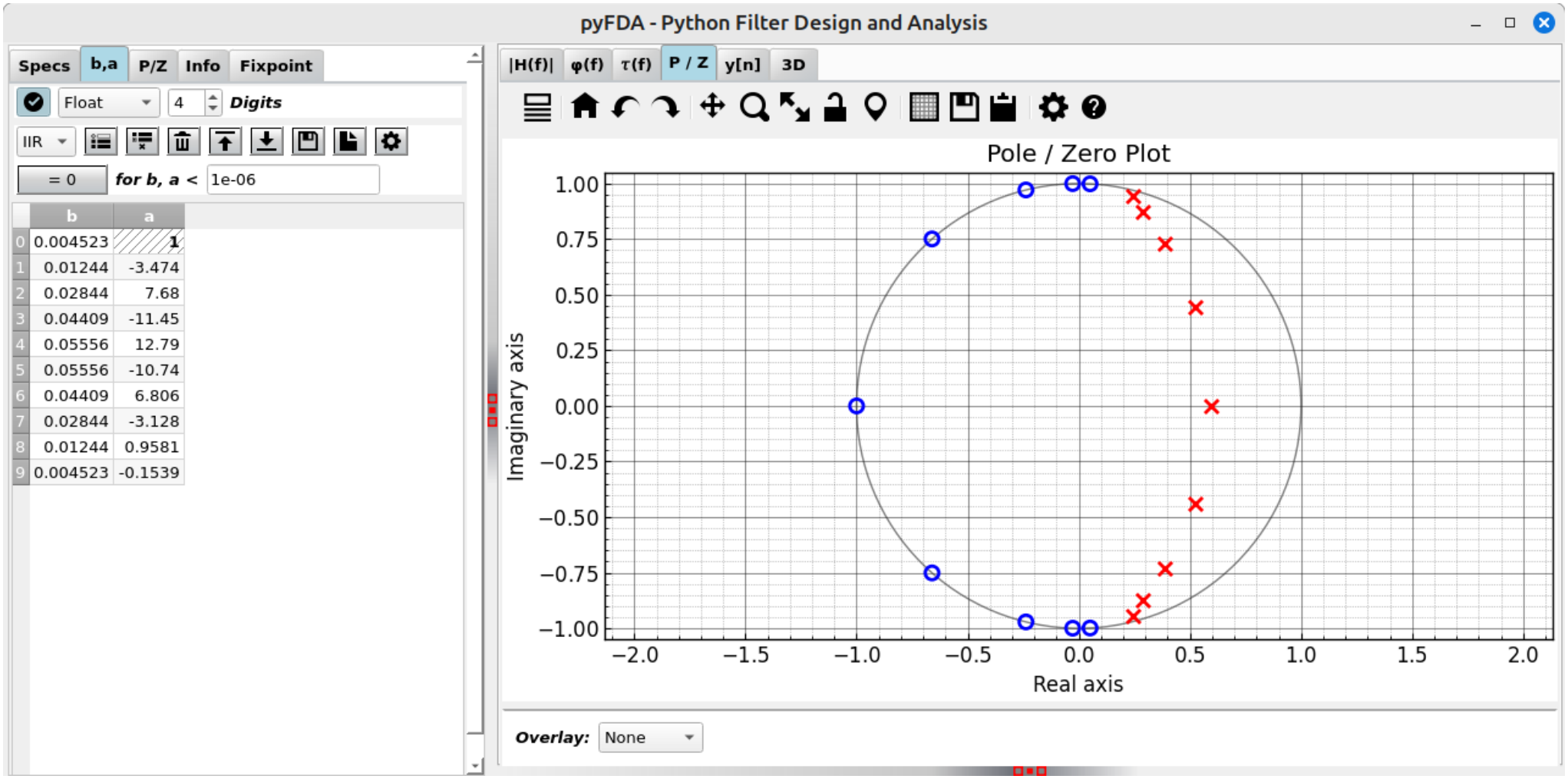
- Generate synthesizable Verilog code for fixpoint filters using e.g. amaranth

Demo (1): Filter Design



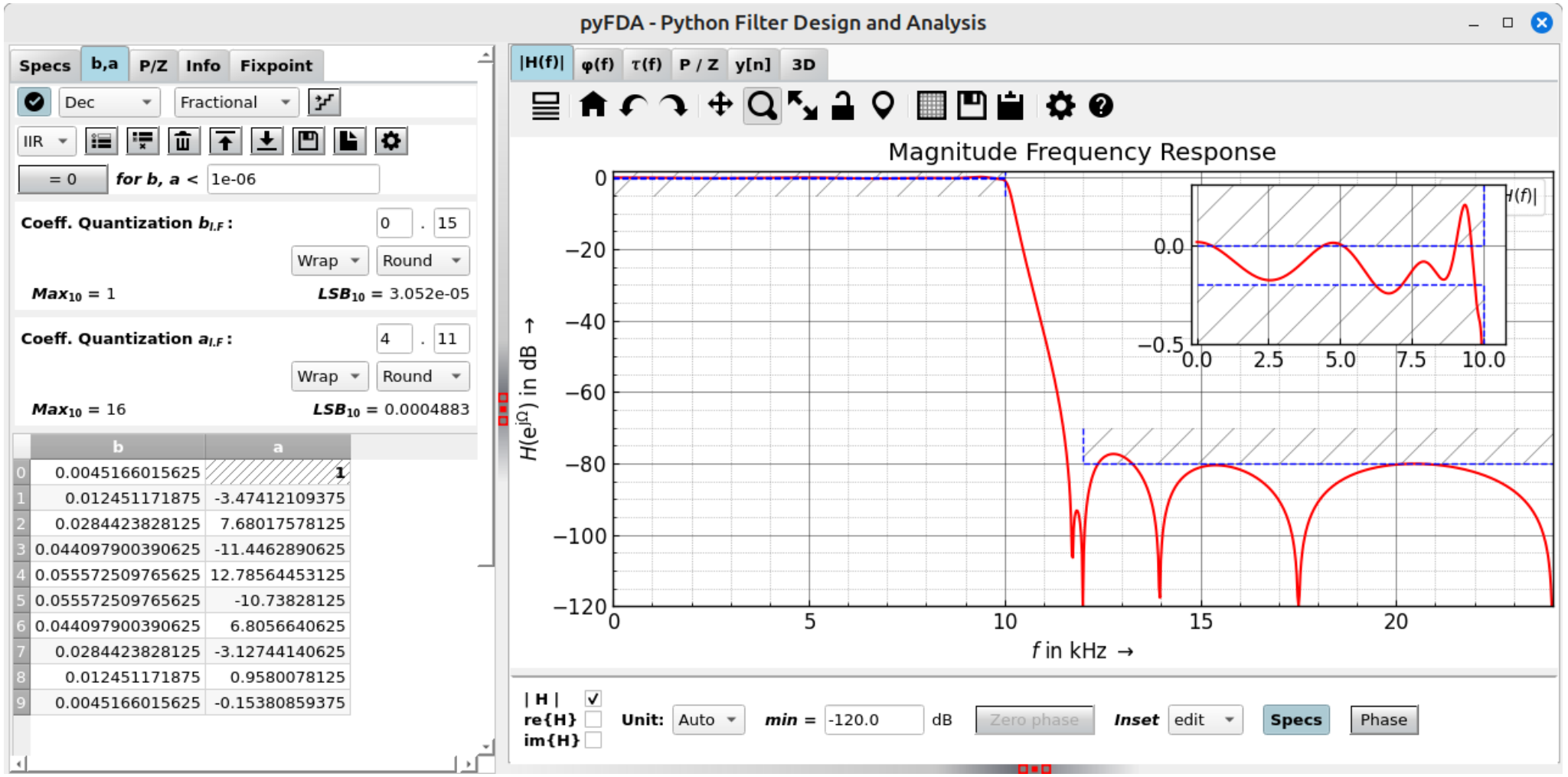
Design filter to meet frequency domain specs with minimum order

Demo (2): Coefficients and Poles / Zeros



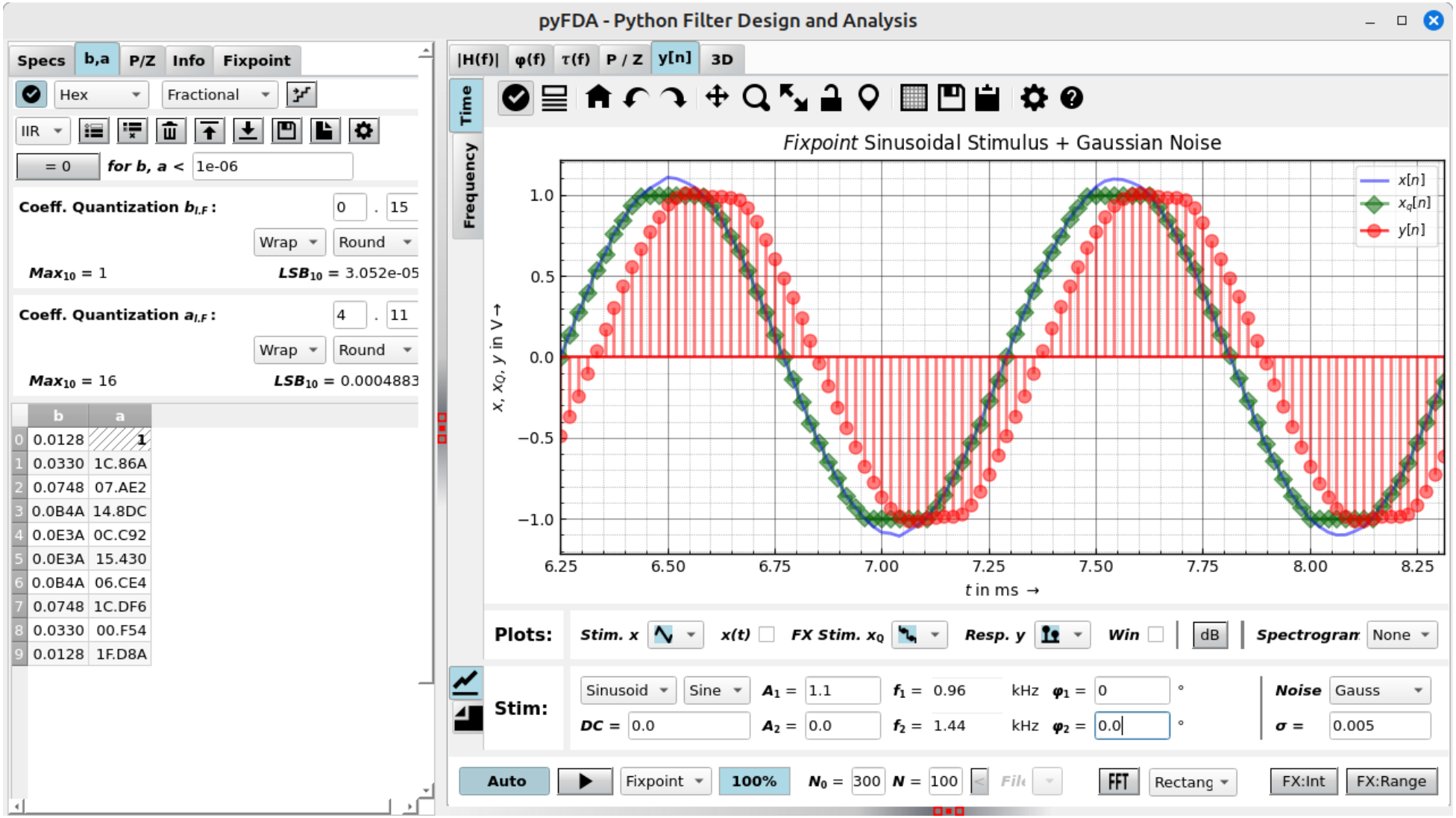
Check filter coefficients and pole / zero positions

Demo (3): Error due to Fixpoint Coefficients



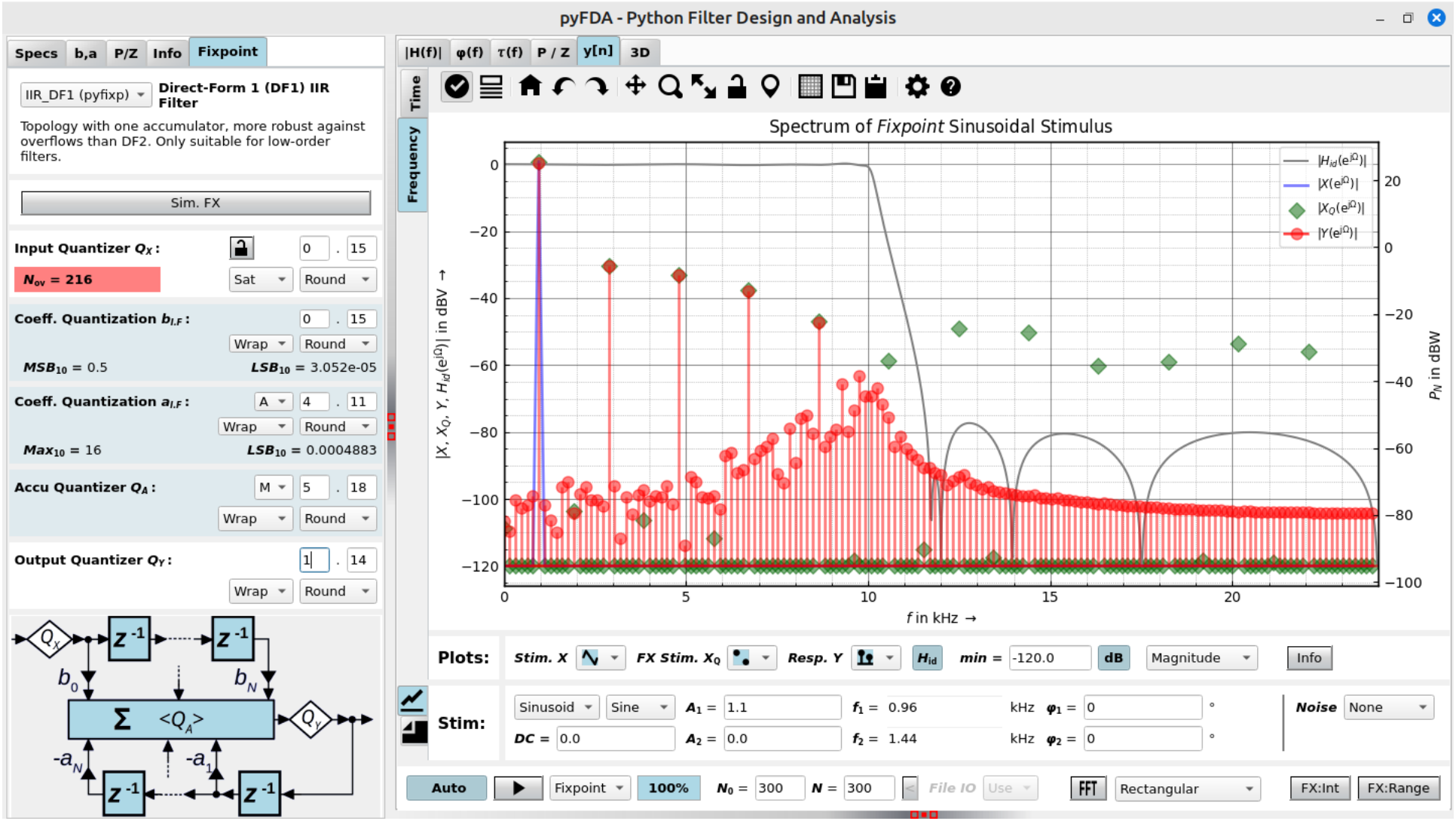
Quantize coefficients to 16 bit resolution, resulting in degraded magnitude response

Demo (4): Fixpoint Transient Response



View coefficients in hex format. Transient response of fixpoint filter to noisy, clipped input signal.

Demo (5): Simulate Fixpoint Arithmetics



Spectral representation of signals from last slide together with ideal filter response

Help wanted

- Feedback from more R & D users, not only DSP course attendants
- Implementation of fixpoint filter topologies in a DSL (e.g. amaranth)
  for generation of synthesizable Verilog
- Verify generated Verilog against Python testbench using cocotb

Contact and social media

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www.youtube.com/c/christian_munker (tutorials coming soon)